MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

EEM1016 – ENGINEERING MATHEMATICS I

(ME / RE / TE)

17 OCTOBER 2018
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTION TO STUDENT

1. This Question paper consists of 5 pages with 4 questions only.
2. Attempt **ALL FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided. All necessary working **MUST** be shown.
4. Only **NON-PROGRAMMABLE** calculator is allowed.

Question 1 [25 marks]

(a) Find $\frac{dy}{dx}$ of the following functions:

(i) $y = \ln(sin(3^x \cos(x)))$ [2 marks]

(ii) $xy^3 - 2x^4y = 1 - \ln y$ [2 marks]

(b) Evaluate the following integral:

(i) $\int \frac{\ln(5x)}{x^8} dx$ [3 marks]

(ii) $\int \frac{(x^2+3)}{x+1} dx$ [4 marks]

(c) Determine whether the following sequence converges, and if it does, find the limit.

$$a_n = \frac{n^4 + 5n}{\sqrt{25n^8 + n^4 - 8}}$$

[3 marks]

(d) Determine whether the following series is convergent.

$$\sum_{n=1}^{\infty} \frac{n^{\sqrt{2}}}{8^n}$$

[4 marks]

(e) Find the radius and the interval of convergence of the following power series:

$$\sum_{n=1}^{\infty} \frac{x^n}{(2^n)\ \sqrt{n^2 + 5}}$$

[7 marks]

Continued...

Question 2 [25 marks]

(a) The following is a wave equation that is important for the description of waves.

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

Determine the value c if,

(i) $u = 3x^2 + 5t^2$ [4 marks]

(ii) $u = \sin(2x)\cos(3t)$ [4 marks]

(b) If $u = x^2y^3$, where $x = e^t \sin(t)$ and $y = t^2 + 5$, determine $\frac{du}{dt}$ using Chain Rule.

[6 marks]

(c) Use Lagrange multiplier to find the maximum and minimum values of the function:

$$f(x, y, z) = 4x + 6y + 8z + 10$$

subject to:

$$g = 4x^2 + 3y^2 + 8z^2 = 6$$

[11 marks]

Continued...

Question 3 [25 marks]

(a) Given that $z_1 = \sqrt{3} + i$ and $z_2 = 1 - i$

(i) Evaluate z_1/z_2 and put the answer in Cartesian form. [3 marks]

(ii) Evaluate $z_1 z_2$ and put the answer in Polar form. [3 marks]

(iii) Using De Moivre's Theorem, prove that

$$3z_1^3 + 12z_2^2 = 0$$

[6 marks]

(iv) Find all the roots for $z^2 = z_1$. [4 marks]

(b) Find an equation that passes through the point $P(1,4,6)$ and is orthogonal to the plane $3x + 8y + 2z = 124$. Also, determine the point of intersection.

[9 marks]

Continued...

Question 4 [25 marks]

(a) Suppose that $f(x)$ is a periodic function with period $2L$. State the general formula of a Fourier series for $f(x)$, and the expressions of its coefficients.

[5 marks]

(b) A signal generated on the interval (–2, 2) is defined by the function,

$$f(x) = \begin{cases} x+1 & if -2 \le x < 0 \\ x-1 & if\ 0 \le x < 2 \end{cases}$$

where $f(x+4) = f(x)$

(i) Sketch the graph of the function $f(x)$ on interval (–6, 6). [5 marks]

(ii) Find the Fourier coefficient a_n of the function $f(x)$, where $\mathrm{n} = 0,1,2,\ldots$

[3 marks]

(iii) Find the Fourier coefficient b_n of the function $f(x)$, where $\mathrm{n} = 1,2,\ldots$

[8 marks]

(iv) Hence, find the Fourier series of the function $f(x)$. [4 marks]

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